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SECTION 220.00 – PHASE I (G) GEOLOGICAL RECONNAISSANCE REPORT

PHASE I (R) REHABILITATION FOR PAVEMENT REPORT

The purpose of the Phase I Materials Report and Geologic Reconnaissance is for geologic reconnaissance of corridors and to provide the designer with general information that will assist in the preparation of the design concept report. For pavement rehabilitation, the Phase I (R) report consists of pavement design.

For new alignment and major realignment projects, materials information in the Materials Phase I Geological Reconnaissance Report is developed to the extent needed to identify the geologic conditions and constraints which may influence the choice of alignment and to identify the pavement type. Once a tentative alignment is selected then detailed geologic information regarding the proposed alignment, and preliminary and working design criteria are developed during the course of the Phase II soils investigation. The designer should be aware that information developed in the Phase II soils investigation may generate changes in the alignment.

The following report outline shall be used for both Phase I investigations and geologic reconnaissance reports. For corridor studies, the recommendations sections may be brief or presented in general terms. The Phase I report would contain a relatively brief topography and geology section with an expanded site specific geologic constraints and recommendations section. Adequate maps and exhibits, such as a vicinity sketch and geologic map, must be included. Reference any relevant reports or previous investigations.

The Pavement Structure Analysis, [Section 540.00](#), and Life Cycle Cost Analysis, [Section 541.03](#), shall be attached and submitted with the Phase I report. The Phase I Report, the Engineering Report, and the Life Cycle Cost Analysis will all become attachments to the Concept Report. A Life Cycle Cost Analysis program is available from the Headquarters Materials Section or through the Materials web site.

On projects involving widening, minor relocation (curve flattening, etc.), the designer needs preliminary materials design criteria to develop the concept report. An abbreviated Phase I report shall be submitted on these projects. On projects primarily consisting of pavement rehabilitation or pavement reconstruction, a Phase I (R) report shall be submitted (refer to [Section 225.00](#)).

In preparing the abbreviated Phase I report, geologic description may be omitted along with geologic mapping. The report should consist of an Introduction ([Section 220.01](#)), sections on Surface Water ([Section 220.04](#)), Groundwater ([Section 220.05](#)), Geologic Constraints or Hazards ([Section 220.06](#)) which are appropriate, and Recommendations ([Section 220.07](#)). Reference relevant reports or previous investigations.

220.01 Introduction. Begin the report with a statement of purpose and scope of investigation. Describe the area covered, length of corridor, proposed alignment length, corridor width, termini, and route number. Indicate scope of the project (new alignment, realignment, etc.).

220.02 Conclusions. State conclusions regarding the relative geologic feasibility of proposed alignment(s). Indicate major geologic conditions and constraints influencing feasibility of the alignment(s). Refer to subsequent sections in the report where constraints are discussed. Include general conclusions regarding the choice of alignment(s) or changes in alignment(s). Refer to maps where appropriate.

In large reports, this section may be replaced by a summary, which briefly states the results of the investigation. Typical summaries do not exceed 1 to 1 ½ pages.

220.03 Topography and Geology.

- Topography

Provide information on the relief of the area under study, existing ground slopes, elevation range, valley or drainage width, and grade. Indicate if alignments parallel or cross topographic features, i.e., ridges, stream valleys, etc.

- Geomorphology and Stratigraphy

Describe the land forms which influence any new alignment(s), and discuss the geologic units which will be encountered. Present the stratigraphic section(s) and the influence of stratigraphy on the alignment(s) for any grade changes. Refer to mapping.

- Geologic Structure

Describe the structure of the geologic units and its influence on any new alignment(s). Include discussions of faulting, joints, bedding, foliation, attitudes, etc. Include structural attitudes on the geologic map.

- Soils and Vegetation

Describe the distribution and thickness of soil units including top soil. Indicate types and distribution of vegetation in the study area. Include land use as related to soil and vegetation.

220.04 Surface Water. Describe the surface drainage pattern and its influence on roadway location. Include information on high water, erosion, deposition, influence of lithology, and geologic structure on surface drainage patterns, etc.

For to-be-constructed bridge locations over a channel, obtain representative samples near the streambank and evaluate for sizing of riprap material and design of erosion control geotextile. When entering a channel with equipment, the conditions of U.S. Army Corps of Engineers 404 Permit Requirements may apply and an Idaho Department of Water Resources Stream Alteration Permit or written approval may be required.

State the D_{50} and the D_{90} sizes of the streambed material. Also, state the D_{15} , D_{50} , and D_{85} sizes of the in-situ material at the abutment or channel side slope locations.

D_{xx} is the material size for which xx% by weight of the particles are smaller.

220.05 Groundwater. Cover the occurrence and distribution of subsurface water. Provide estimates of depth to groundwater. Cite observations which provide evidence for depth estimates. Include information regarding current groundwater uses. Provide measurements and yield data on existing wells and springs. Describe the influence of geology on groundwater and the influence of groundwater on the proposed highway construction.

220.06 Geologic Constraints. Outline the constraints or hazards presented to highway construction by geologic conditions.

- **Seismic Risk**
 - Discuss past and future earthquake occurrence in the project region. Potential hazards from seismic activity include fault rupture, ground shaking, slope failure, settlement, and liquefaction. Discuss the potential influence of these factors on the proposed construction. Indicate locations of potential problem areas. Estimate the peak firm ground acceleration coefficient anticipated (10% chance of exceedence in 50 years) by using [Figure 250.05.08.2](#) in this manual.
- **Faults**
 - Note location(s) of active and potentially active faults in the project vicinity. Discuss the influence of faults and shear zones (active or inactive) on proposed construction. Faulting typically will influence slope stability and groundwater flow.
- **Landslides**
 - Indicate presence and location of existing landslides, and their influence on highway construction. Discuss possible mitigation techniques; avoidance, stabilization, removal, etc. Also, indicate areas of potential instability, including talus deposits.
- **Water**
 - Discuss potential for flooding and indicate where special construction techniques will be needed, i.e., drainage, erosion protection, etc. Estimate the effect of construction on groundwater flow and indicate possible ways to mitigate adverse effects.
- **Settlement and Embankment Foundation**
 - Describe subsurface conditions below proposed embankments and indicate locations where significant settlement of embankments may be expected. Identify relatively deep, loose, or soft soil deposits that indicate potential embankment foundation instability.
- **Geologic Structure of In-Situ Rock Formations**
 - Indicate influence of bedding, foliation, joint attitudes, and contacts on construction, i.e., adverse dip or joint intersections may dictate rock slope angles or require support.
- **Highway Construction Materials**
 - Discuss the availability of borrow sources, aggregate sources, and waste sites. Include environmental constraints to developing sources or waste sites, i.e., wetlands, zoning, etc. Include both existing ITD controlled sources and contractor furnished sources in the area.

220.07 Recommendations. Even in very early stages of project development, preliminary design criteria are needed for preliminary cost estimates and comparison of alternatives. In corridor studies, these design criteria will be largely qualitative, and most of the recommendations will be contained in the preceding sections. In Phase I, a tentative alignment is established and more quantitative, but preliminary design criteria are still needed. Indicate locations where special and/or analyses appear warranted.

- Slopes and Embankments

Preliminary recommendations should include applicability of standard cut and fill slopes, and locations where slopes will be governed by geologic conditions (stratigraphy, structure, potential sliding). Indicate areas where sidehill embankments and embankment foundations need special treatment. Include recommended changes in alignment needed to accommodate geologic constraints. Identify potential rockfall problem locations.

- Structures

Indicate types of structure and locations where they will likely be required, if any. Note existing structures and comment on condition.

- Drainage

Provide locations where subdrainage and surface water interception or diversion will likely be necessary.

- Shrink/Swell

Provide estimates for shrink and swell factors for geologic units or groups of materials to be encountered in excavation. These estimates, in conjunction with the local stratigraphic sequence, will provide data for preliminary earthwork analysis.

- Tentative Ballast

Preliminary ballast thickness estimates may be based on the general materials types expected to occur at subgrade. A limited number of R-value tests are performed for typical expected subgrade soils. Make use of adjacent project data where applicable.

- Tentative Material Sources

Indicate the existing materials sources, both ITD controlled and contractor furnished sources, in the project vicinity and the probable material produced. The location of potential sources should be presented as well as a description of probable materials encountered. Give consideration to access and environmental aspects of source development. Use the legal description and a descriptive location in relation to the project.

Typically, ITD will not develop sources for individual projects, rather will put the burden on the contractor to find material for the project. However, the Tentative Materials Sources information provided in this section will give the designer an idea of how to establish materials costs for the project.

220.08 Geologic Mapping. The scale of geologic mapping is left to the preparer. However, the scale should be large enough to show adequate detail. For filing ease, maps should be prepared on sheet sizes which are multiples of 8 1/2" × 11" (215 mm × 280 mm), i.e., 11" × 17" (280 mm × 430 mm), 17" × 22" (430 mm × 560 mm), 22" × 34" (560 mm × 860 mm). Individual sheets should be no larger than 22" × 34" (560 mm × 860 mm), or standard sheets.

A topographic map base is suggested. The geology, structure, and features (such as landslides and high groundwater areas) may be plotted directly on the base map or developed on an overlay or series of overlays. Screened base mapping is often an effective presentation.

The degree of geologic complexity and scope of the project will dictate the detail required. On relatively low relief, geologically simple projects, a standard county map may provide an adequate base (although a larger scale may be needed).

On more complex projects, large scale topography may be needed as a base and additional presentations such as slope maps, groundwater maps, geologic hazards, geologic structure, etc., may be needed.

220.09 References. The following are possible sources of geologic information which may be of use in preparing geologic reports and maps. In this section, provide a list of references used while preparing the report.

- USGS quad sheets, open file reports, professional papers, etc.
- US Bureau of Reclamation reports
- Aerial Photo Coverage
- University-developed geologic studies
- Soil Conservation Service soil mapping
- Bureau of Land Management
- US Forest Service
- Department of Energy
- Idaho Geological Survey
- US Bureau of Mines
- Annual Engineering Geology and Soils Engineering Symposia

With the exception of aerial photos in the Roadway Design Section, limited geologic mapping, ERTS imagery, and seismic risk data in the Materials Section, geologic references are not available through Headquarters.

SECTION 225.00 – MATERIALS PHASE I (R) REHABILITATION FOR PAVEMENT REPORT

A Phase I (R) Rehabilitation for Pavement Report is appropriate for projects designated as pavement rehabilitation projects, including but not limited to pavement overlays, CRABS, mill and inlay, cold in place recycle and hot in place recycle. The level of field work required, such as pavement condition information, preliminary pavement drilling and/or test pits, and FWD testing will be the same as for a full Phase II report and is presented in greater detail in the following sections. The Phase I (R) Rehabilitation for Pavement Report is developed at the concept stage and repetition/re-review of essentially the same information and report during the design phase is not necessary unless changes are necessary. As previously described, an Abbreviated Phase I with full Phase II, III, and V reports is considered appropriate for widening, minor relocation and reconstruction projects.

225.01 Report Format. The following is considered to be an appropriate format for a Phase I (R) Report for pavement rehabilitation projects. In addition, all applicable sections from the Abbreviated Phase I and Phase II report format should be addressed in the Phase I (R) Report. The information corresponding to some sections may be omitted as repetitive or not relevant for pavement rehabilitation projects without explanation.

225.01.01 Introduction. Describe the characteristics of the roadway covering location, materials history, and current condition. Include rutting, cracking, and roughness indices. Briefly state or describe the roadway characteristics such as grade, approximate super elevations, shape condition of the roadway crown, etc. Identify any primary usage and traffic characteristics that are anticipated to affect project design in ways other than for analysis purposes.

225.01.02 Evaluation. Provide detailed description of roadway characteristics such as grade, approximate super elevations, shape condition of the roadway crown, etc. Provide additional description of cracking, rutting, roughness, edge breaking, etc. as needed.

Discuss resultant information from [Section 530.00](#), Pavement Rehabilitation Design including discussion of information from [Section 540.00](#), Pavement Structure Analysis as appropriate. Particular attention should be given to existing pavement thickness, truck ADT, and pavement subsurface drainage.

Provide explanation(s) of any primary usage and traffic characteristics that are anticipated to affect project design in ways other than for analysis purposes, as needed.

Identify any geologic or environmental features that may pose a constraint on the project. Such features may include, but are not limited to, areas presenting potential rockfall hazard, landslides, or obvious wetlands.

Briefly discuss or identify available materials sources in the area of the project. Provide a brief description of anticipated materials quality.

Identify any structures that may exist on the project and comment on condition.

Identify any pipes that may exist on the project and comment on condition.

Identify any roadway locations where sub-subgrading, or full reconstruction will be needed. Address compaction and subsurface drainage.

Discuss pavement geotextile or any other non-usual products or procedures that are being considered.

225.01.03 Analysis. Provide required total design pavement thickness as described in [Section 230.08](#), based on existing layer thicknesses. If more than one design life is being evaluated, show the required total design pavement thicknesses, based on existing layer thicknesses, for each design life being considered.

Where appropriate, provide pH and resistivity information from soil tests that may have been taken. Refer to [Design Manual](#) for selection of pipe materials.

Provide initial quantity estimates for any dust abatement that may be required.

Provide justification for any materials-related, non-pavement rehabilitation work that is being recommended.

225.01.04 Alternates. Describe each alternate being considered. Address each alternate to the pavement descriptions discussed in the Evaluation. List the Equivalent Uniform Annual Cost (EUAC) and/or Total Net Present Worth for each alternate.

Provide justification for any non-usual products or procedures integral to an alternate.

225.01.05 Conclusions and Recommendations. State conclusions in regards to each alternate as developed in the report. Select and recommend the design alternate with the highest priority being the potential of that alternate to address the pavement rehabilitation needs of the project. The secondary priority for selection of the design alternate will be economics.

225.01.06 Appendix. Attach the following:

- Vicinity Map
- Data and analysis sheets from Pavement Structure Analysis
- Life Cycle Cost Analysis
- Manufacturer or vendor information and sample specifications for any non-standard materials or procedures to be used.

SECTION 230.00 – PHASE II SOILS REPORT

The purpose of the soils report is to provide designers with specific information concerning the soils (or rock) encountered over the length of the project and geotechnical recommendations regarding slopes, embankments, and drainage required to construct the project to current design standards. Also included are sources, descriptions of borrow materials required on the project, and pavement structure thicknesses. Investigations for aggregate sources may not be complete, but should be in progress at this stage. An outline of the soils report and description of the information required follows.

On projects primarily consisting of pavement rehabilitation or pavement reconstruction, a Phase I (R) report generally addresses the Phase II Soils issues of concern. Refer to [Section 225.00](#). If a Phase I (R) Report has previously been repaired, a Phase II Report may be needed only to address work to be done that is in addition to pavement rehabilitation or pavement reconstruction. On projects involving widening, minor relocation (curve flattening, etc.), an abbreviated Phase II report may be prepared.

In preparing the abbreviated Phase II report, care must be taken to ensure all relevant sections of the report are included. At a minimum, the report should consist of an Introduction ([Section 230.01](#)), Vicinity Sketch ([Section 230.02](#)), Soils Profile/Pavement Condition Survey ([Section 230.03](#)), Total Design Pavement Thickness ([Section 230.08](#)), Surface and Subsurface Water ([Section 230.16](#)), Drainage ([Section 230.17](#)), Existing Roadway Material ([Section 230.20](#)), References ([Section 230.29](#)), and any other sections that are appropriate. Permission to submit an abbreviated Phase II report does not relieve the author of the responsibility of preparing a complete and thorough report.

230.01 Introduction. Include a brief description of the project. Address the type of project (new alignment, realignment, widening, rehabilitation of existing, etc.) length, width, and grades; types and numbers of structures; existing facilities; and approximate heights of cuts and fills. Describe the alignment and terrain (level, rolling, stream valley, side hill, mountainous, etc.). An elevation range should also be included as well as a brief description of the geology, soils, and vegetation. Reference previous reports and investigations and subsequent investigations proposed.

230.02 Vicinity Sketch. Prepare the project vicinity sketch on a county map base in accordance with [Figure 230.02.1](#). The sketch should show project limits, location of all sources, stockpile sites and waste sites.

230.03 Soils Profile/Pavement Condition Survey. For new alignments or realignments, prepare a soils profile in accordance with [Figures 230.03.1](#) and [230.03.2](#). Cross sections should be included on the soils profile to illustrate typical conditions over the project, special problems, or areas where detailed analyses were made. All boring logs should be shown on the profile and located on the cross sections. One print of the soils profile should be submitted to the Headquarters Materials Section for review. After the review, the soils profiles will be returned to the district. Soils Profiles may be prepared on a roll of paper or on sheets at plan size (11" × 17").

A pavement condition survey should be submitted when an existing route is upgraded, widened, or rehabilitated and construction will not result in significant changes in vertical or horizontal alignment. Include copies of the test pits or borings from the Pavement Condition Survey along with the report. The Pavement Condition Survey is performed as part of the Pavement Structural Analysis ([Section 540.00](#)).

Figure 230.02.1

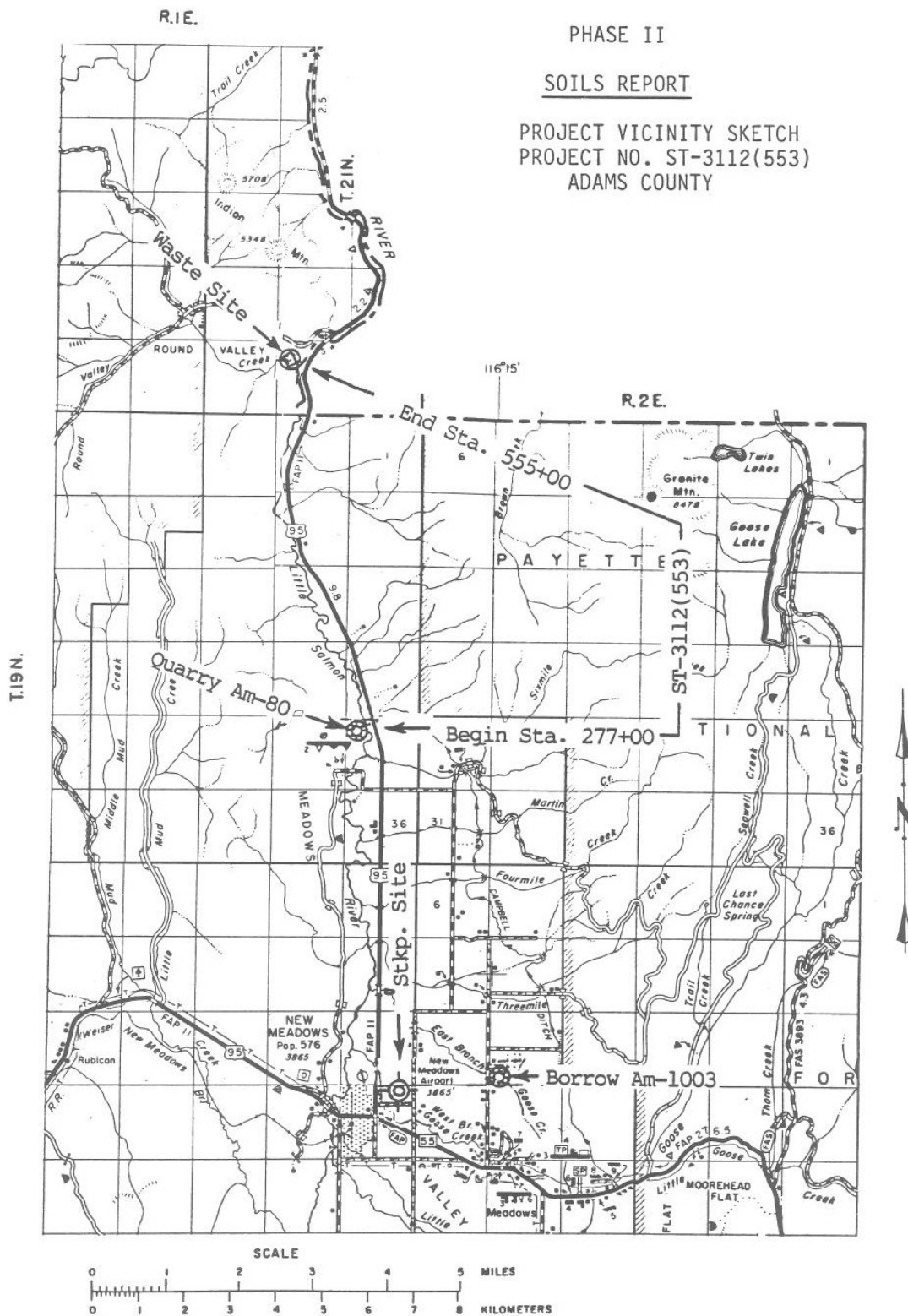
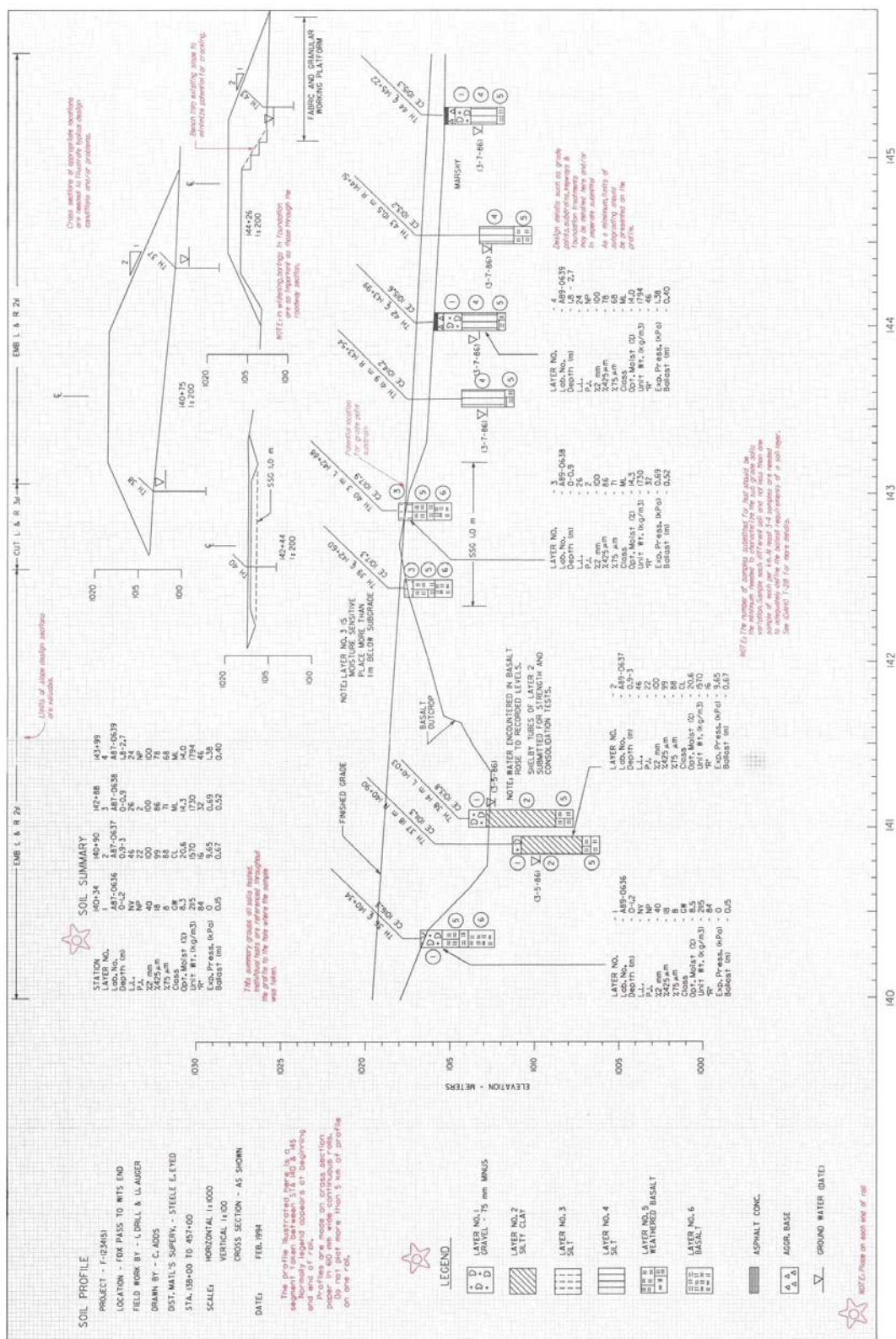


Figure 230.03.2



A pavement condition survey shall include a description of the surface condition, recap of the service and rehabilitation record, deflection, testing, and an investigation to determine the thickness of each pavement structure component. Samples shall be taken of the subgrade soils for resistance value (R-value) and expansion pressure tests; base and subbase materials for gradation, sand equivalent, and R-value tests; and surfacing materials to determine the extent of stripping, apparent brittleness, and asphalt content.

An abbreviated Combined Phase I-II Report may be prepared for projects requiring only a pavement condition survey. Where the roadway is to be widened, soils profile width cross sections and a description of special problem areas shall be included.

230.04 Borrow Source Data. Provide the following information for each source when designated sources are specified.

Source Location	Exp. Press. In psi (kPa)	R-Value	Proven Quantity in c.y. (m ³)	Design Est. Qty Req. in c.y. (m ³)
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Note any special or selective uses of material from sources, i.e., top soil, select granular material, drain aggregate, use of overburden, etc. Also note special processing which may be needed. If material required exceeds 75% of the proven quantity, then the designer should notify the District Materials Section to confirm the material quantity.

For existing sources, use established county and number code designation for location. The source designation codes and previous test data are available from District or Headquarters Materials Section.

When Contractor Furnished Sources are to be used, indicate in this section that Approved Contractor Furnished Sources are specified.

- Example:

Approved Contractor Furnished Sources are specified.

230.05 Aggregate Inventory Report. Provide the following information for each source when designated sources are specified.

Source Loc.	Ave. Haul Miles	Depth of Over- burden ft. (m)	Max. Size in. (mm)	S.E.	Immer. Comp.	Proven Quantity C.Y. (m ³)	Recl.* Plan Approv.	Arch.* Clear.
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*Provide dates

Indicate the quantities of material required for the project. Provide a recommended or selected source and reasons for selection.

If expansion pressure controls, so note.

When Contractor Furnished Sources are to be used, indicate in this section that Approved Contractor Furnished Sources are specified.

- Example:

Approved Contractor Furnished Sources are specified.

230.06 Borrow and Aggregate Source Plats. When designated sources are specified, submit copies of drawings; retain originals for final design submittal in the contract proposal to ensure good clear drawings. (Compare source drawings to the example shown in [Figure 270.07.02.1](#) in [Section 270.07.02.](#))

When Contractor Furnished Sources are to be used, indicate in this section that Approved Contractor Furnished Sources are specified.

- Example:

Approved Contractor Furnished Sources are specified.

230.07 Soil Report Summary. On new alignment, realignment, and widening projects, record the main traveled way and station-to-station locations showing where material will originate for subgrade construction (Form [ITD-944](#)). Do not place high ballast requirement materials at subgrade. Cap with material having low ballast requirements. For example, see [Figure 230.07.1](#), Form [ITD-944](#).

For pavement rehabilitation projects, a Soil Report Summary is normally not necessary. The following example illustrates a pavement rehabilitation project.

- Example:

This project consists of pavement rehabilitation and no Soil Report Summary was prepared. Boring logs and test pit logs from The Pavement Condition Survey are included in the appendix.

230.08 Total Design Pavement Thickness. Show station-to-station tentative ballast using the following headings:

Sta. to Sta. MP to MP	Actual Thickness in feet (meters)				Design Gr.* Equivalency
	Surface	Base	Sub-base	Total	

*For plant mix pavement.

If the Total Design Pavement Thickness was determined as part of the Phase I report, reference that report. If the thickness was not determined in the Phase I or has changed for some reason, calculate the Total Design Pavement Thickness and include all information used to determine it in the appendix of the Phase II report.

The pavement thicknesses shown here are determined by the design procedures described in [Section 510.00](#), Thickness Design for Flexible Pavement. For other design procedures described in [Section 500.00](#), Pavement Design, use only the applicable parts of the table.

All pavement designs over two years old shall be checked for need of reevaluation.

Figure 230.07.1



PHASE II SOILS REPORT SUMMARY

PROJECT NO. S-2775(3) Wendell Spur DATE Feb. 02, 1976

CROSSING ROAD FRONTAGE ROAD RAMP MAIN TRAVELWAY STATION TO STATION	MATERIAL FROM CUT STATION TO STATION	LAYER ROW NO.	BOR- ROW NO.	SOILS AT SUBGRADE LAB. NO.	R VALUE	K VALUE	EXPAN- SION PRES- SURE	TRAF. INDEX	TRAF. CLASS	TOTAL FLEXIBLE PAVEMENT THICKNESS			RIGID PAVEMENT THICKNESS		UN- TREATED BASE
										ACT. EXP. PRES.	GRAVEL EQUIV. R VAL.	DESIGN EQUIV.	CONCRETE SLAB	TREATED BASE	
468+4.5 - 473+00		3		261243	22			8.5			2.2	0.9	1.2*		
473+00 - 475+00		1		261242	68			8.5			0.9	0.9	1.2		
475+00 - 483+00	473+00 - 475+00	1		261242	68			8.5			0.9	0.9	1.2		
483+00 - 489+00	473+00 - 475+00	1		261242	68			8.5			0.9	0.9	1.2		
489+00 - 493+00	489+50 - 492+20	2		261245	64			8.5			1.0	0.9	1.2		
493+00 - 504+00	509+50 - 518+84.8	5		261246	65			8.5			1.0	0.9	1.2		
504+00 - 506+00		5		261246	65			8.5			1.0	0.9	1.2		
506+00 - 509+50		3		261247	47		1.14	8.5		1.3	1.5	0.9	1.2**		
509+50 - 518+84.8		5		261246	65			8.5			1.0	0.9	1.2		
Borrow (if needed)			60108	221673	59		0.80			0.9	1.2				
* Undercut to 2.0' in soil - Back fill to subgrade with existing roadway ballast													468+94.5 - 472+50		
** Undercut to 1.5' in soil - Back fill to subgrade with existing roadway ballast													506+00 - 509+50		

This form is used as a tool for design of ballast depths. It represents a section of roadway showing where the soil came from in that section (in-place, borrow or cut section), the lab. number of the soil that the ballast design is based on, pertinent test information of the soil and the design thickness of the section. Design thickness must meet the minimum requirements but consideration must also be given to length, number and practicability of the resulting ballast sections. Placement of materials must be determined through use of the soils profile, computer quantity runs, borrow haul diagram, or special conditions. Unusual conditions may be shown by note at the bottom of the sheet or on attached separate sheet.

Innovations may also be used in given situations, for example, the profile shows a fill section of 1.5 ft. over an in-place soil having a ballast requirement of 2.0 ft. with borrow having a ballast requirement of 1.0 ft. The design of one or two sections of this nature could be shown by note. If there are several sections involved, it might be more practical to use a second sheet and show a second design for the in-place soil independent of the design for the borrow.

GRAVEL EQUIVALENT SUBSTITUTION RATIOS: PLANT MIX 2:1 ROAD MIX _____ C.T.B. _____ AGGREGATE BASE 1:1 GRANULAR BORROW 3/4:1

230.09 Sub-grading. Prepare a station-to-station list of any areas requiring additional excavation (and thicker pavement section) below pavement subgrade due to groundwater or undesirable soil characteristics. Define the limits of sub-subgrading (SSG) on the Soils Profile for reference. Indicate material requirements for backfill and location for disposal of excavated material. Indicate reason for sub-subgrading. If special drainage and/or a subgrade blanket or geotextile is needed, refer to subsequent sections of the report where they are described.

Sub-subgrading should not be confused with over-excavation for embankment foundation.

230.10 Grade Pointing. Grade pointing is sub-subgrading to remove undesirable soils from cut-fill transitions, provide drainage, and/or eliminate abrupt transitions. Installation of perforated pipe drains in grade points, particularly at the downgrade end of cuts, can be beneficial in reducing pavement distress (frost heave, pumping, differential settlement, etc.) in the embankment at or near the grade point. Grade points may be either transverse, longitudinal, or skewed. Again, indicate materials requirements for backfilling and location for disposal of excavation. Note locations of pipe drains. Show limits defining grade points as follows:

Station-to-Station	SSG in feet (meters)	Drainage Direction
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230.11 Special Placement. Designate station limits when it is necessary to haul material beyond its logical location on the mass diagram and place it elsewhere, i.e., sub-subgrade excavation, subgrade cap, top soil, or special placement of rock fill.

230.12 Compaction. Specify class of compaction recommended and locations. Special compaction requirements described in subsequent sections of this report should be referenced here. Class C compaction must be defined separately by stations. Refer to [Subsection 205](#), Excavation and Embankment in the [ITD Standard Specifications](#) for compaction classes.

230.13 Slope Design Summary. Designate slopes of all cuts and fills in the summary outlined below. Include special treatment such as pre-splitting, benching, mini-benching, serration or toe keys, sub-drainage, and benching for embankment construction. Indicate dimensions on benches, slopes, and embankments as well as station-to-station locations for slopes requiring special treatment such as retaining walls, rock fall mitigation ditches, interceptor ditches, and interceptor drains. Assign shrink and swell values to the various geologic units that will be encountered in excavation. Use these values to determine average shrink and swell factors for material from each cut or series of cuts. These values should be entered into the summary outlined below.

These slope and special treatment recommendations should be more fully described in subsequent sections of the report. Embankment slopes should be included in the summary and referenced to [Section 230.14](#). Use the following headings for Slope Design Summary.

Sta. to Sta.	Operation	Ht. in feet (meters)	Shrink/Swell (volume change)	Slope	Special Treatments
--------------	-----------	-------------------------	---------------------------------	-------	-----------------------

The Slope Design Summary should be provided for every project where design includes special slope treatments or slopes are more than ten feet (three meters) high.

- An example summary is shown in [Figure 230.13.1](#).

On other projects, such as pavement rehabilitation, the slope design summary information may require only a brief written statement.

- Example:

Slopes shall be constructed at 2:1 or flatter.

- Example:

This project consists of pavement rehabilitation and a slope design summary was not performed.

Figure 230.13.1 – Slope Design Summary

Station Limits	Operation	Ht. in m (ft.)	Shrink/ Swell	Slope	Special Treatment
0+00-22+60	Cut L Daylight R	18 (60)	+15%	0.5:1	Pre-split; 15' (5 m) FBD*; 10' (3 m) Bench Elev. 5,590' (1704 m) *(Flat-Bottomed Ditch)
22+60-28+10	Cut L Fill R	6 (20) 3 (10)	-5%	1.5:1 2:1	Interceptor Crown Ditch: Serrated Slope Toe Keyway 7' +/- (2 m +/-) Deep and Drain Station 23+20-27+69; Contour Sub-drain Elev. 5530' +/- (1685 m +/-)
28+10-38+40	Series of Low Cuts and Fills	0-3 (0- 10)	-10%	Standard	Serrated Slopes
38+40-42+60	Fill L & R	12 (40)		1.5:1	Rockfill; Toe Keyway 10' (3 m) Deep Sta. 39+90-40+20

230.14 Slope Design. Indicate basis for slope designs presented above, including special slope treatments and ditches. A station-to-station summary is suggested. Discuss erosion control recommendations such as mini-benches and serrations. Equally important, indicate slopes on which mini-benching or serrations should not be constructed. Reference special reports or addendum's which have or will be prepared for areas requiring special investigation or analysis.

Include assigned or measured strength properties used or needed in analyses. Special recommendations such as grade changes, needed to improve stability, should also be included here. For minor retaining walls such as gabion walls or MSE walls under 10' (3.0 m) in height, the foundation investigation and concept design information may be included here.

Embankment slope recommendations should be discussed. Where all embankment slopes will conform to standards, one sentence to that effect will be adequate. Special slope ratios recommended for stability, erosion, etc., and geosynthetics and features such as counter berms should be discussed in this section. Refer to the [Erosion and Sediment Control \(BMP\) Manual](#) where appropriate.

230.15 Embankment Foundation. Indicate amount and time required for consolidation or settlement of embankment foundations. Discuss stability analyses performed for embankments and/or reference special reports or addendums. Describe recommended special treatments for stability improvement, to mitigate settlement, or facilitate placement. These treatments may include geotextiles, drain blankets, foundation drainage, toe keyways, benching, over excavation, wick drains, surcharging, waiting periods, counter berms, etc. Designate locations or areas of treatment by station. Refer to other sections of this report if special treatments are described elsewhere, i.e., [Section 230.17](#), Drainage.

230.16 Surface and Subsurface Water. Describe surface water which may require special treatments such as pond or ditch relocation or interceptor ditches. Note groundwater depth and locations where groundwater may cause problems during construction. Show monitored or measured flow data. Evaluate effect of construction on local aquifers and discuss need for well monitoring and replacement water systems. Well data is needed for at least two years prior to construction to establish a base yield level.

230.17 Drainage. Describe drainage features required, and designate locations or areas by station. Reference special reports or addendums which have been or will be submitted and/or special investigations needed. Reference other sections of report such as [Section 230.15](#), Embankment Foundations, if features are described therein. Include dimensions of drain systems, pipe sizes, aggregate design criteria, geotextiles, drain spacing, depth, discharge point, need for erosion protection, etc.

230.18 Retaining Walls. Indicate station-to-station limits and heights of retaining structures required. Reference special investigations and/or Phase IV reports which have been or will be submitted. Phase IV reports may not be needed for walls less than ten feet (three meters) high, and gabion walls three baskets or less in height.

Special investigations will be required for tied back walls, soil nail walls, slurry walls, and other retaining structures requiring structural design. Detailed information for design should be presented in the Phase IV report.

230.19 Blanket Course or Filter Material. Designate, by station interval, any blanket material required for finishing sub-grades, preventing pumping, or covering embankment foundations. The blanket course may be aggregate with or without a geotextile, as appropriate. Filters will typically be geotextiles.

The successful function of blankets and filters depends on their relationship with the material upon which the blanket or filter is placed. Include gradation, permeability, and soil classification data on materials to be blanketed or filtered.

For aggregate blankets, include gradation, thickness, source, and any other pertinent criteria.

For geotextiles, indicate intended function and suitable types; certain functions may require geotextiles to be woven or non-woven, slit film, needle punched, UV stabilized, etc. Approximate ranges of required geotextile properties should be recommended, such as permeability, apparent opening size, and survivability (strength) criteria.

Note that survivability (high, moderate, low) is a function of subgrade conditions and of thickness and particle size in the initial lift of aggregate or granular borrow. Indicate need for sewn seams, if required. Refer to Standard Specifications [Subsection 640](#), Construction Geotextiles and [Subsection 718](#), Geotextiles for specifications.

Refer to [Section 511.00](#) Subgrade Separation and Filtration for additional information.

230.20 Existing Roadway Material. Prepare a station-to-station list of existing roadway material which will be utilized in new construction. Designate the item and its intended placement location. Also indicate if existing material is to be wasted or removed and stockpiled.

For pavement rehabilitation projects, the existing material normally is either wasted or must remain in-place as is the case for a CRABS project.

- Example:

All existing roadway material shall be recycled and shall remain on the roadway. No material may be removed from the project unless approved by the Engineer.

230.21 Abutment Embankment Material. Designate material to be used in embankments supporting structures. Include material requirements and source, and indicate need for selective removal or special treatment such as screening. Reference Phase IV reports for the structure.

230.22 Rock Subgrade. Where granular borrow or other material (including membranes) will be used to finish exposed rock subgrades, provide station-to-station location, source, and material requirements (gradation, SE, thicknesses, etc.).

230.23 Topsoil. Indicate recommended depths and locations for removal of topsoil; note stockpile areas, and make a general statement regarding handling and use of the material. In some cases soil tests may need to be performed to determine the soils suitability for sustaining plant growth. Obtain representative samples from existing topsoil layer and the underlying layer of soil parent material. If sufficient topsoil cannot be generated from the project, contractor furnished sources must be used. (See [Section 270.09](#))

230.24 Pipe. List station-to-station locations showing physical properties of bedding materials in the format shown below. Within the station limits of soils where the pH is outside the range of 6 to 9 or where resistivity is less than 1000 ohm-cm, take individual tests at each site that requires a pipe larger than 24" (610 mm). Confirm results that fall in the special design area of the selection chart ([Design Manual, Figure 6-2](#)) by check tests. Test the bed of all live streams.

The condition of existing pipe should be checked for all projects. For projects where pipe replacement is not within the scope of work or intent of the project, indicate in this section the replacement of pipes is not anticipated on the project. However, the condition of all pipes within the project limits should be checked and reported so damaged pipes are not covered with a new roadway. It may be possible to program a project to replace pipes not originally intended to be replaced or allow maintenance crews the opportunity to replace them if the condition is known early enough. Complete information will allow the designers to decide how they want to handle the situation.

Pipe Data				
Station-to-Station	Foundation Unified Soil Class	pH	Resistivity (ohm-cm)	Bed Load*

*A = Abrasive N = Non abrasive

A recommendation to the designer with the type or types of pipe that will meet the materials criteria may be provided here. Information for a final determination of the type of pipe to be used is included in the Design Manual.

230.25 Riprap. It is advisable to use a contractor furnished source for all riprap required.

Unless previously addressed, state the sizes of in-situ and streambed material as described in [Section 220.04](#) Surface Water.

Indicate sizes and thickness of riprap required. Recommend placement methods and need for geotextiles and/or cushion layer.

230.26 Staged Construction. If staged construction is desirable such as to allow for consolidation of embankments to accommodate high water, etc., indicate locations, time periods, and/or dates. Staged Construction normally does not refer to project staging or phasing resulting from programming needs or from traffic control needs.

230.27 Dust Abatement. Show total requirements for dust abatement. Recommend type and quantity of dust abatement needed.

- Example:

Approximately 5000 cubic meters of water will be required for dust abatement, assuming 0.15 cubic meters of water per square meter of subgrade.

230.28 Seismic Design. Indicate project proximity to active and potentially active faults and include estimated peak, firm ground, acceleration coefficients (10% probability of exceedence in 50 years, see [Figure 250.05.08.1](#) in [Section 250.05.08](#)). Where peak, firm ground coefficients are greater than 0.10, delineate locations of high potential seismic hazards, i.e., potential rockfall, high groundwater areas where fills are low or have steep slopes, areas where slides in cuts or fills could disrupt emergency traffic or disrupt traffic on critical routes, etc.

230.29 References. List references used to perform analyses and develop recommendations.

Typical references available in the District or Headquarters Materials Section include:

- Materials Manual [Section 500.00](#).
- TRB Publications
- NAVFAC DM-7
- FHWA Research and Development Reports
- NHI Manuals

- Geotextile Engineering
- Rock Slope Engineering
- Rock Blasting
- Geotechnical Instrumentation
- FHWA Soils and Foundations Workshop Manual
- “Soil Mechanics,” Lambe and Whitman
- “Seepage, Drainage, and Flownets,” Cedergren
- “Basic Soils Engineering,” Hough
- Geotechnical Engineering Publications, University of California, Berkeley
- NCHRP Reports
- [ITD Laboratory Operations Manual](#)
- FHWA Checklists and Guidelines for Review of Geotechnical Reports and Preliminary Plans and Specs.